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Bennett

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(54) **SUPPORT FOR INTERNATIONAL SEARCH TERMS-TRANSLATE AS YOU CRAWL**

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(73) Assignee: **RPX Corporation**, San Francisco, CA (US)

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This patent is subject to a terminal disclaimer.

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(60) Provisional application No. 61/053,712, filed on May 16, 2008.

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G06F 17/30 (2006.01)
G06F 17/28 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 17/30864*** (2013.01); ***G06F 17/289*** (2013.01); ***G06F 17/3097*** (2013.01); ***G06F 17/30902*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 17/30864; G06F 17/3097
USPC 707/709–710
See application file for complete search history.

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2009/0024595 A1 * 1/2009 Chen G06F 17/30864

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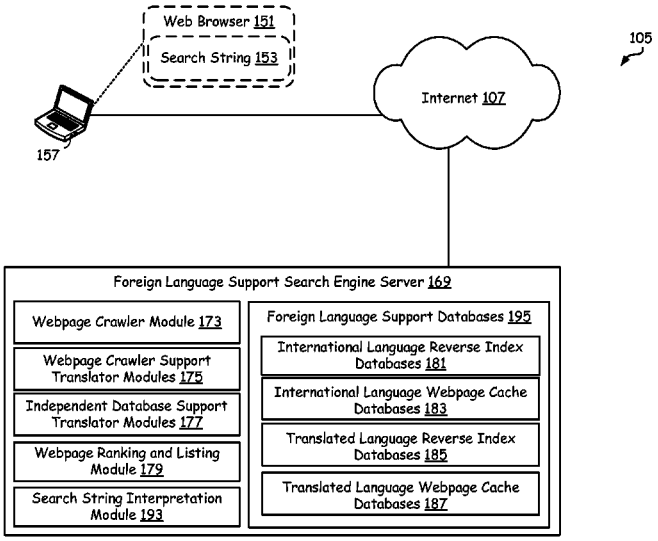
(74) *Attorney, Agent, or Firm* — Howison & Arnott, LLP

(57) **ABSTRACT**

A search engine server delivers search results to a web browser of a client device communicatively coupled to the search engine server via the Internet. The system identifies new web pages in a source language during crawling, translates them into a plurality of destination languages, creates reverse indexes in respective languages, and stores both reverse indexes and cache web pages in a database. Upon the entry of search strings by a user using a web browser, the search engine server responds by delivering links of web pages in the user-desired language (the language of the search string or a language chosen by the user) as well as web pages translated from a plurality of destination languages, ranked based upon popularity or other means. The search engine server contains a plurality of translators that translate new web pages, links that are obtained during crawling, in to a plurality of destination languages.

1 Claim, 10 Drawing Sheets



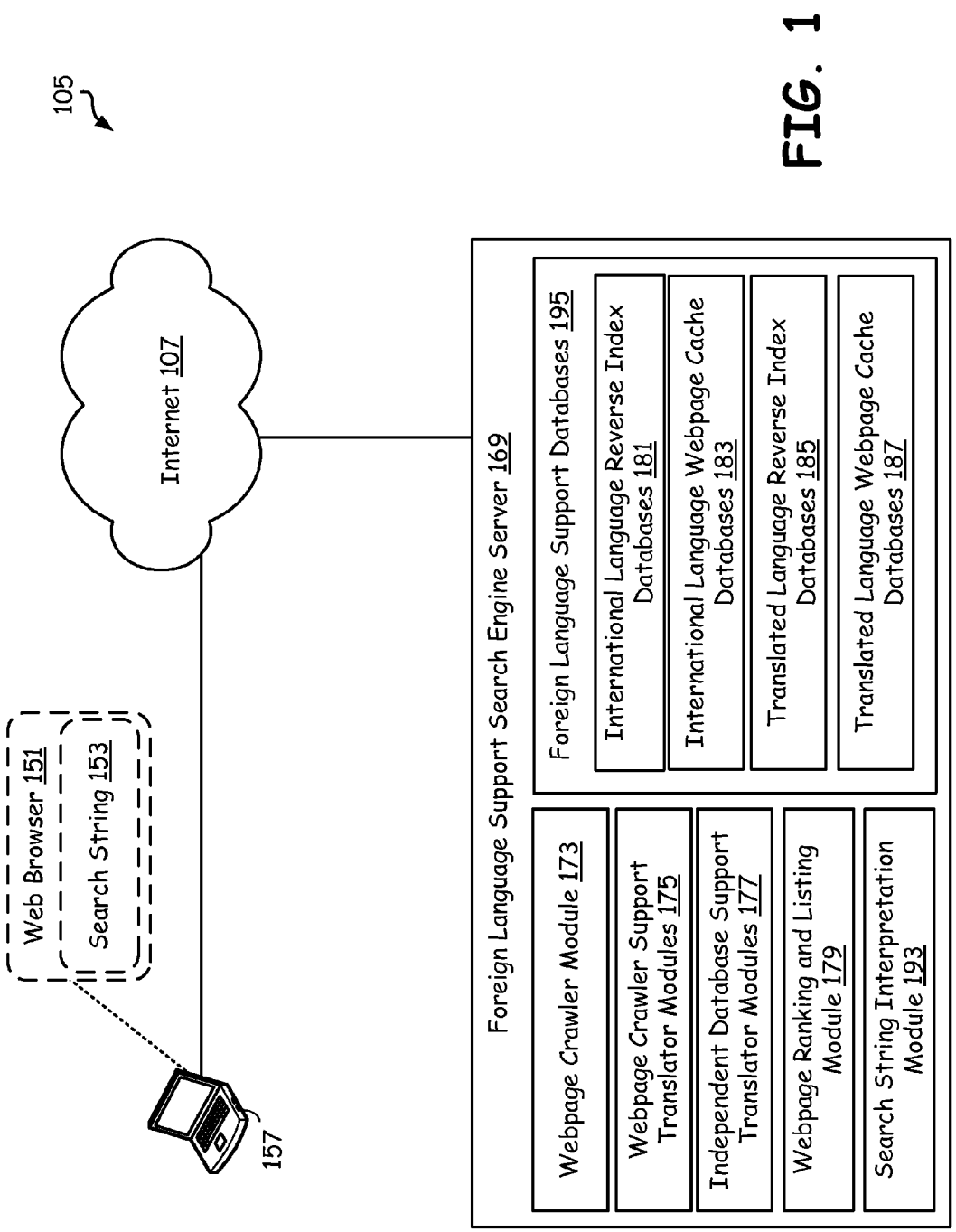

105
Internet 107
Web Browser 151
Search String 153
157
Foreign Language Support Search Engine Server 169
Foreign Language Support Databases 195
International Language Reverse Index Databases 181
International Language Webpage Cache Databases 183
Translated Language Reverse Index Databases 185
Translated Language Webpage Cache Databases 187
Webpage Crawler Module 173
Webpage Crawler Support Translator Modules 175
Independent Database Support Translator Modules 177
Webpage Ranking and Listing Module 179
Search String Interpretation Module 193

FIG. 1

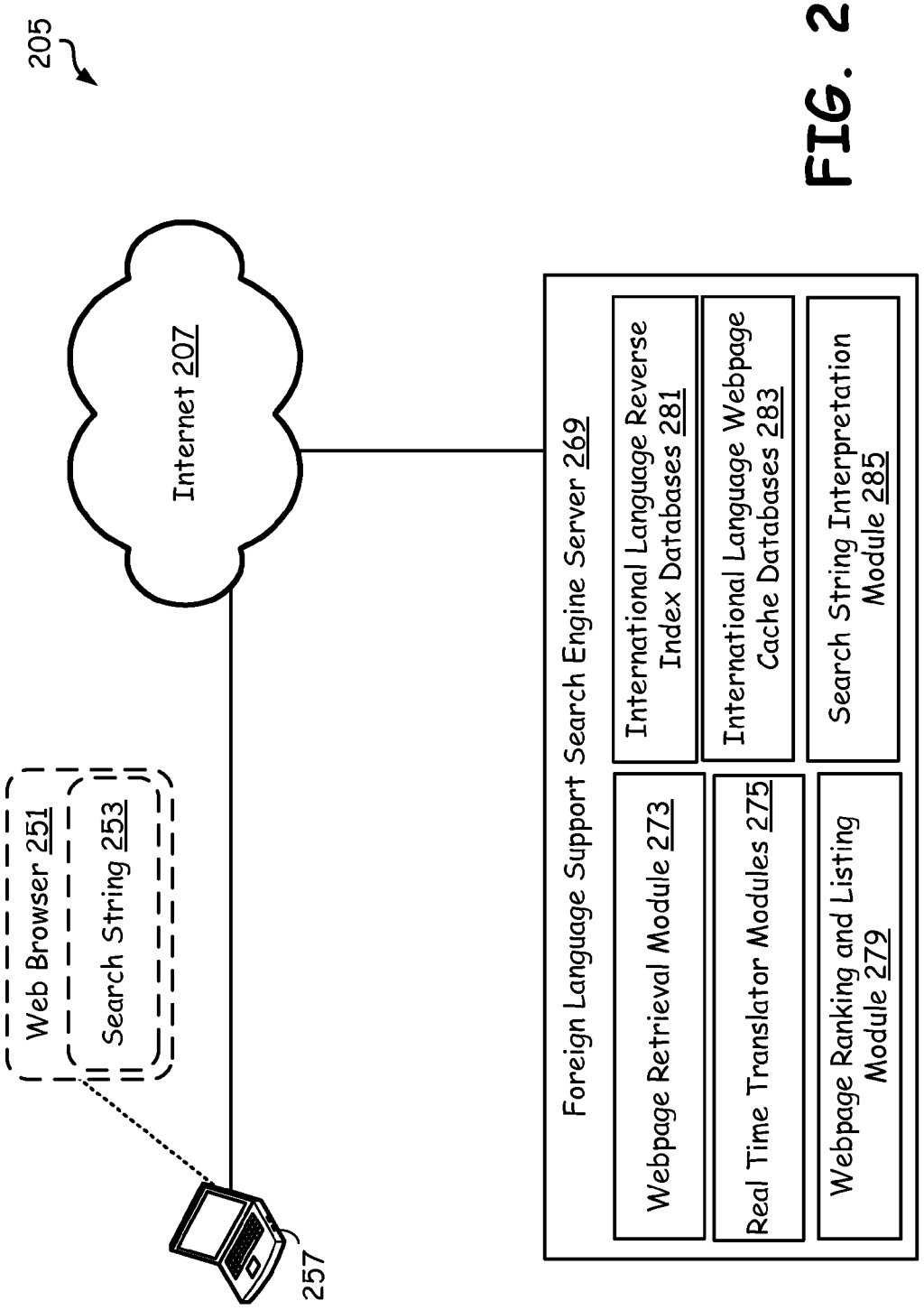

205
Internet 207
Web Browser 251
Search String 253
257
Foreign Language Support Search Engine Server 269
Webpage Retrieval Module 273
Real Time Translator Modules 275
Webpage Ranking and Listing Module 279
International Language Reverse Index Databases 281
International Language Webpage Cache Databases 283
Search String Interpretation Module 285

FIG. 2

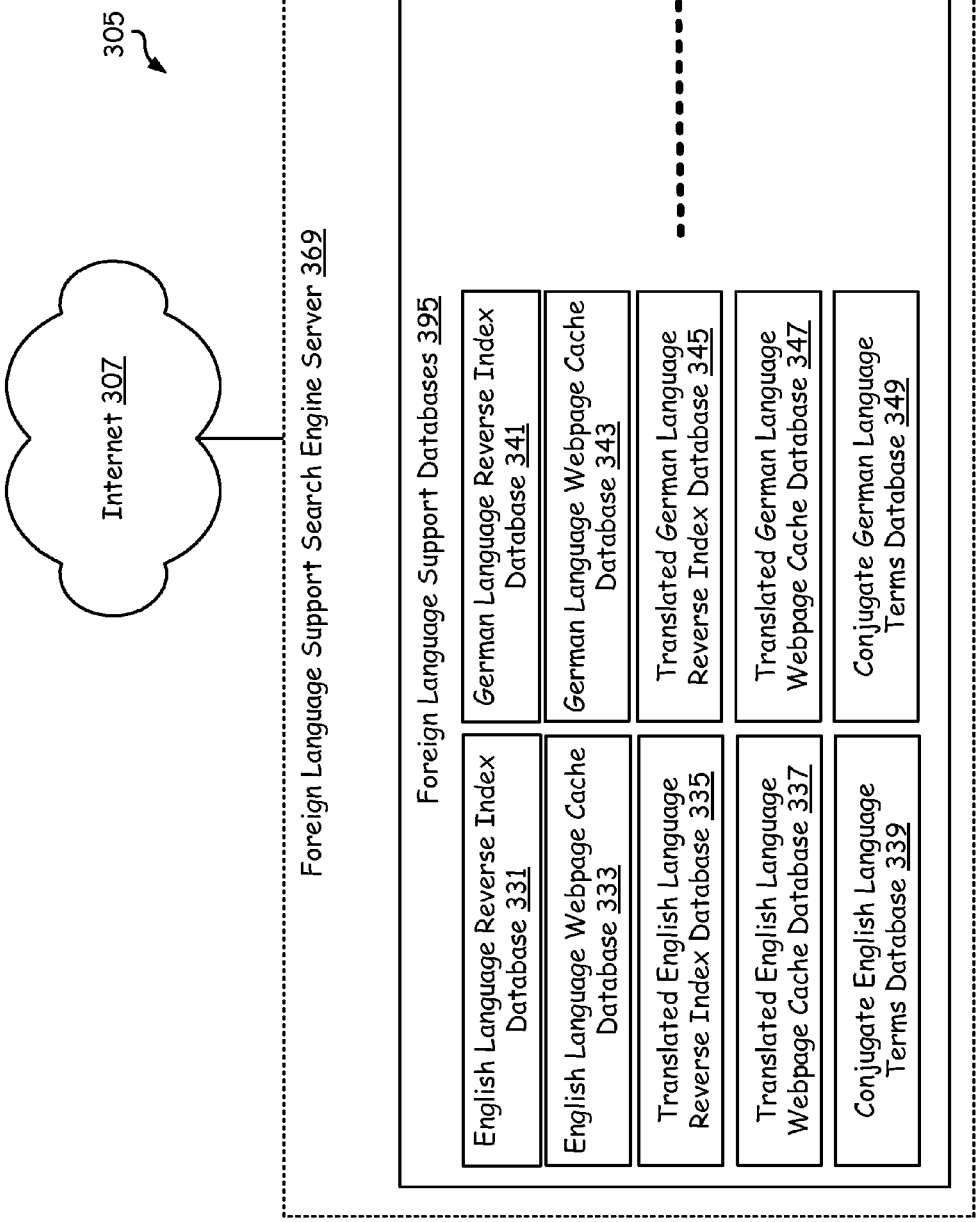

305
Internet 307
Foreign Language Support Search Engine Server 369
Foreign Language Support Databases 395
English Language Reverse Index Database 331
English Language Webpage Cache Database 333
Translated English Language Reverse Index Database 335
Translated English Language Webpage Cache Database 337
Conjugate English Language Terms Database 339
German Language Reverse Index Database 341
German Language Webpage Cache Database 343
Translated German Language Reverse Index Database 345
Translated German Language Webpage Cache Database 347
Conjugate German Language Terms Database 349

FIG. 3

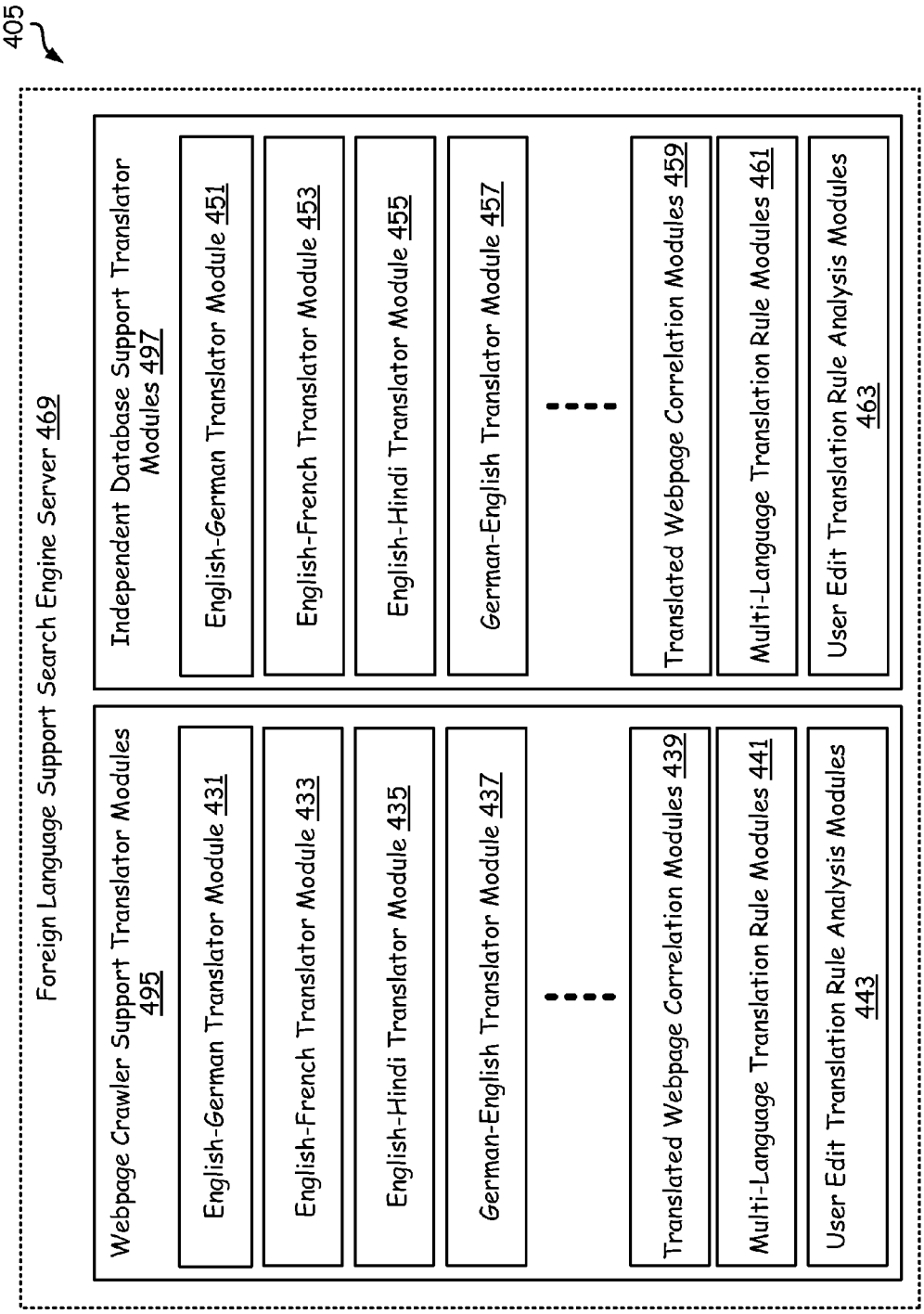

405
Foreign Language Support Search Engine Server 469
Webpage Crawler Support Translator Modules 495
English-German Translator Module 431
English-French Translator Module 433
English-Hindi Translator Module 435
German-English Translator Module 437
Translated Webpage Correlation Modules 439
Multi-Language Translation Rule Modules 441
User Edit Translation Rule Analysis Modules 443
Independent Database Support Translator Modules 497
English-German Translator Module 451
English-French Translator Module 453
English-Hindi Translator Module 455
German-English Translator Module 457
Translated Webpage Correlation Modules 459
Multi-Language Translation Rule Modules 461
User Edit Translation Rule Analysis Modules 463

FIG. 4

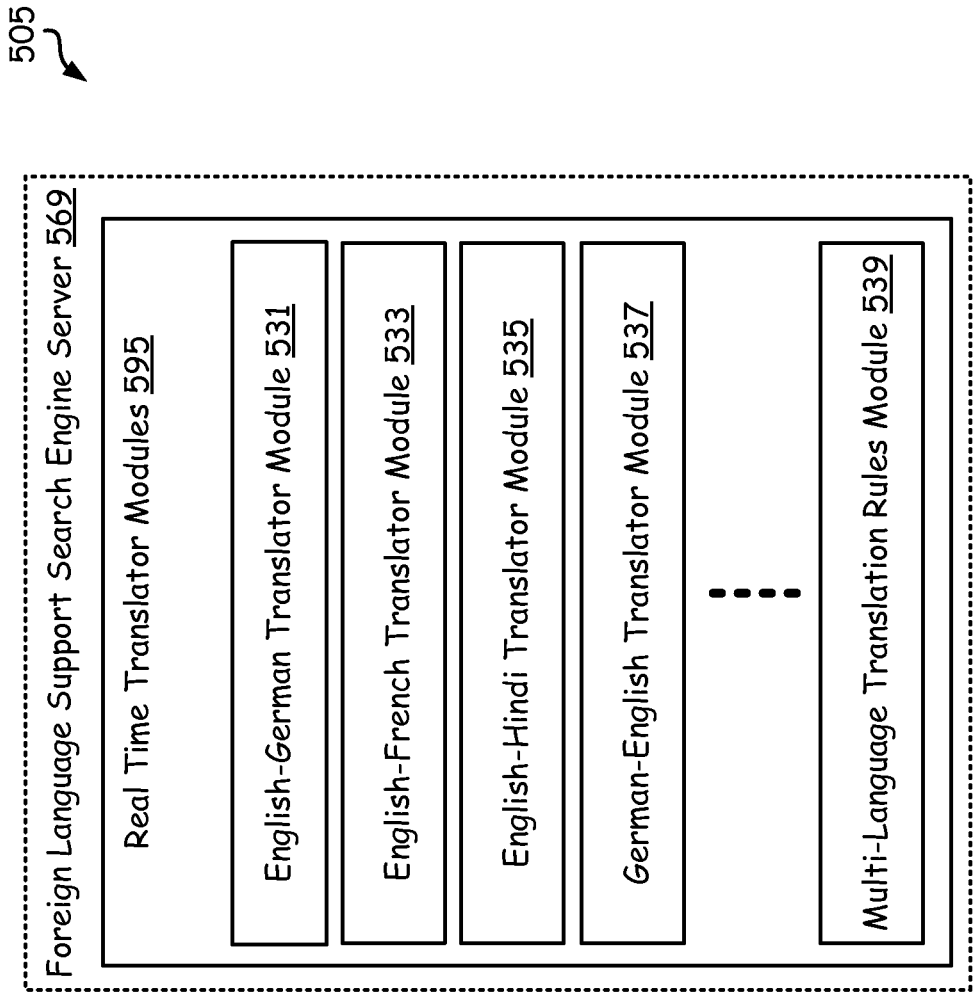

505
Foreign Language Support Search Engine Server 569
Real Time Translator Modules 595
English-German Translator Module 531
English-French Translator Module 533
English-Hindi Translator Module 535
German-English Translator Module 537
Multi-Language Translation Rules Module 539

FIG. 5

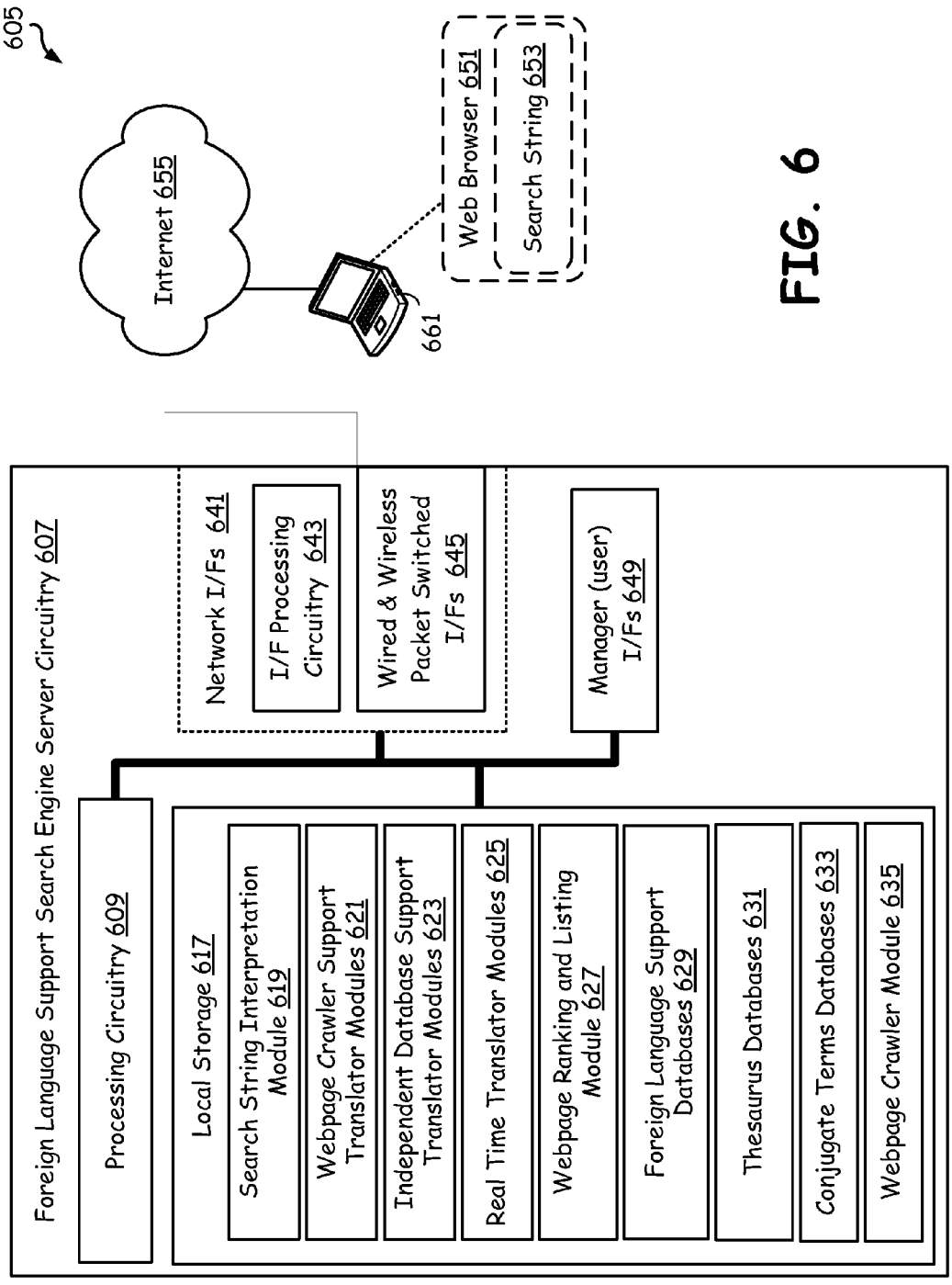

605
Internet 655
661
Web Browser 651
Search String 653
Foreign Language Support Search Engine Server Circuitry 607
Processing Circuitry 609
Local Storage 617
Search String Interpretation Module 619
Webpage Crawler Support Translator Modules 621
Independent Database Support Translator Modules 623
Real Time Translator Modules 625
Webpage Ranking and Listing Module 627
Foreign Language Support Databases 629
Thesaurus Databases 631
Conjugate Terms Databases 633
Webpage Crawler Module 635
Network I/Fs 641
I/F Processing Circuitry 643
Wired & Wireless Packet Switched I/Fs 645
Manager (user) I/Fs 649

FIG. 6

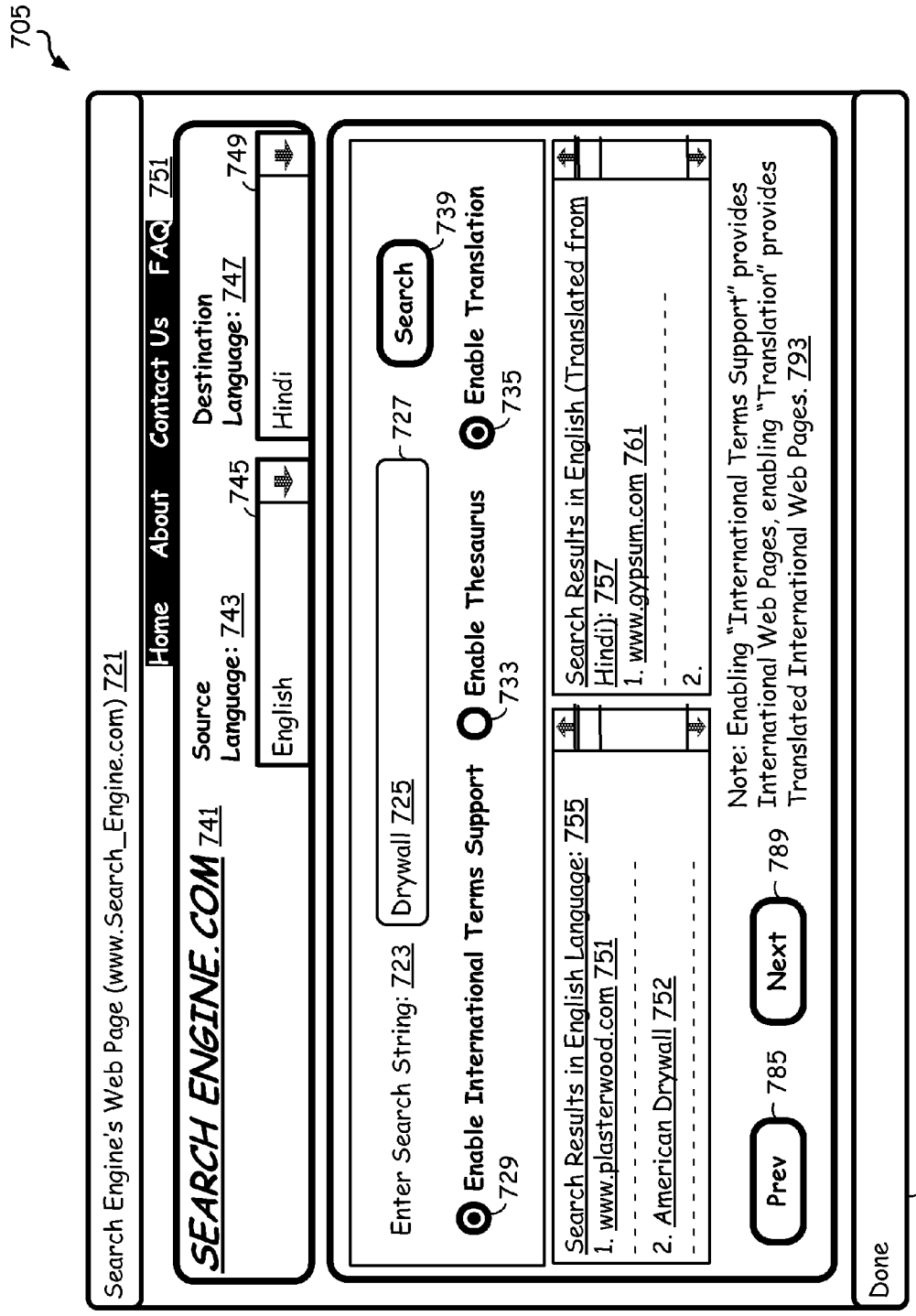

705
Search Engine's Web Page (www.Search_Engine.com) 721
Home
About
Contact Us
FAQ 751
SEARCH ENGINE.COM 741
Source Language: 743
745
English
Destination Language: 747
749
Hindi
Enter Search String: 723
Drywall 725
727
Search
739
Enable International Terms Support
729
Enable Thesaurus
733
Enable Translation
735
Search Results in English Language: 755
1. www.plasterwood.com 751
2. American Drywall 752
Search Results in English (Translated from Hindi): 757
1. www.gypsum.com 761
2.
Prev
785
Next
789
Note: Enabling "International Terms Support" provides International Web Pages, enabling "Translation" provides Translated International Web Pages. 793
Done
Client's Browser 795

FIG. 7

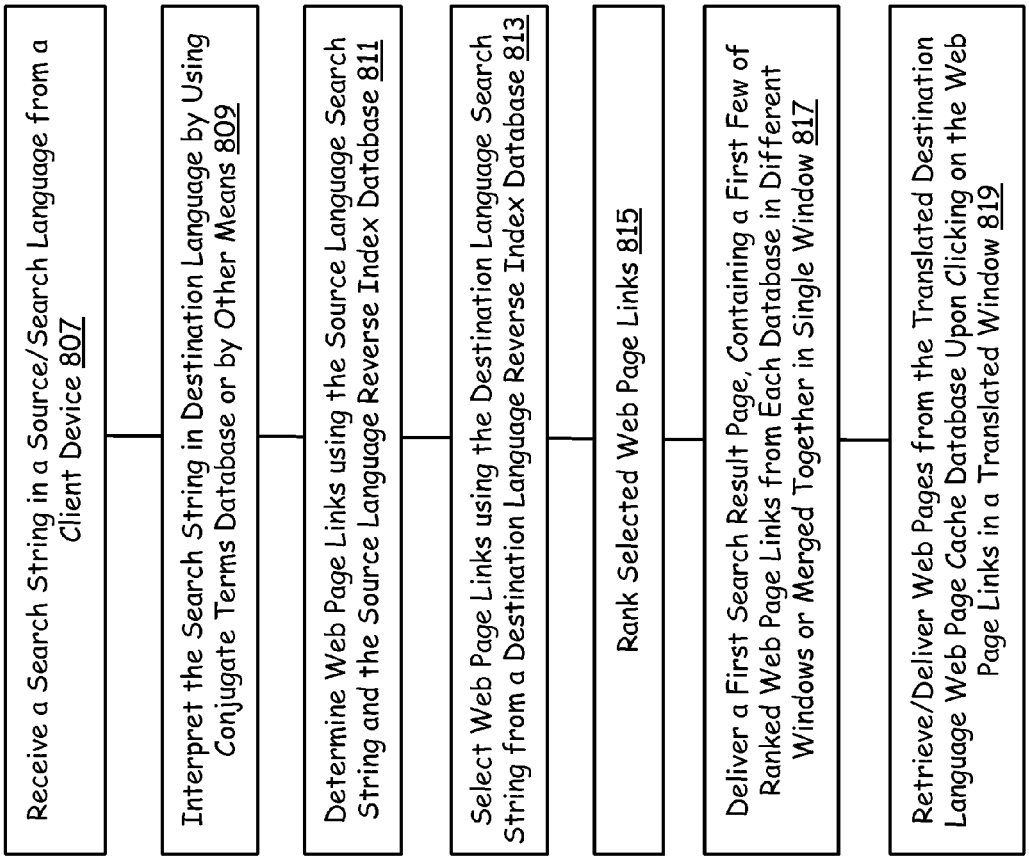

805
Receive a Search String in a Source/Search Language from a Client Device 807
Interpret the Search String in Destination Language by Using Conjugate Terms Database or by Other Means 809
Determine Web Page Links using the Source Language Search String and the Source Language Reverse Index Database 811
Select Web Page Links using the Destination Language Search String from a Destination Language Reverse Index Database 813
Rank Selected Web Page Links 815
Deliver a First Search Result Page, Containing a First Few of Ranked Web Page Links from Each Database in Different Windows or Merged Together in Single Window 817
Retrieve/Deliver Web Pages from the Translated Destination Language Web Page Cache Database Upon Clicking on the Web Page Links in a Translated Window 819

FIG. 8

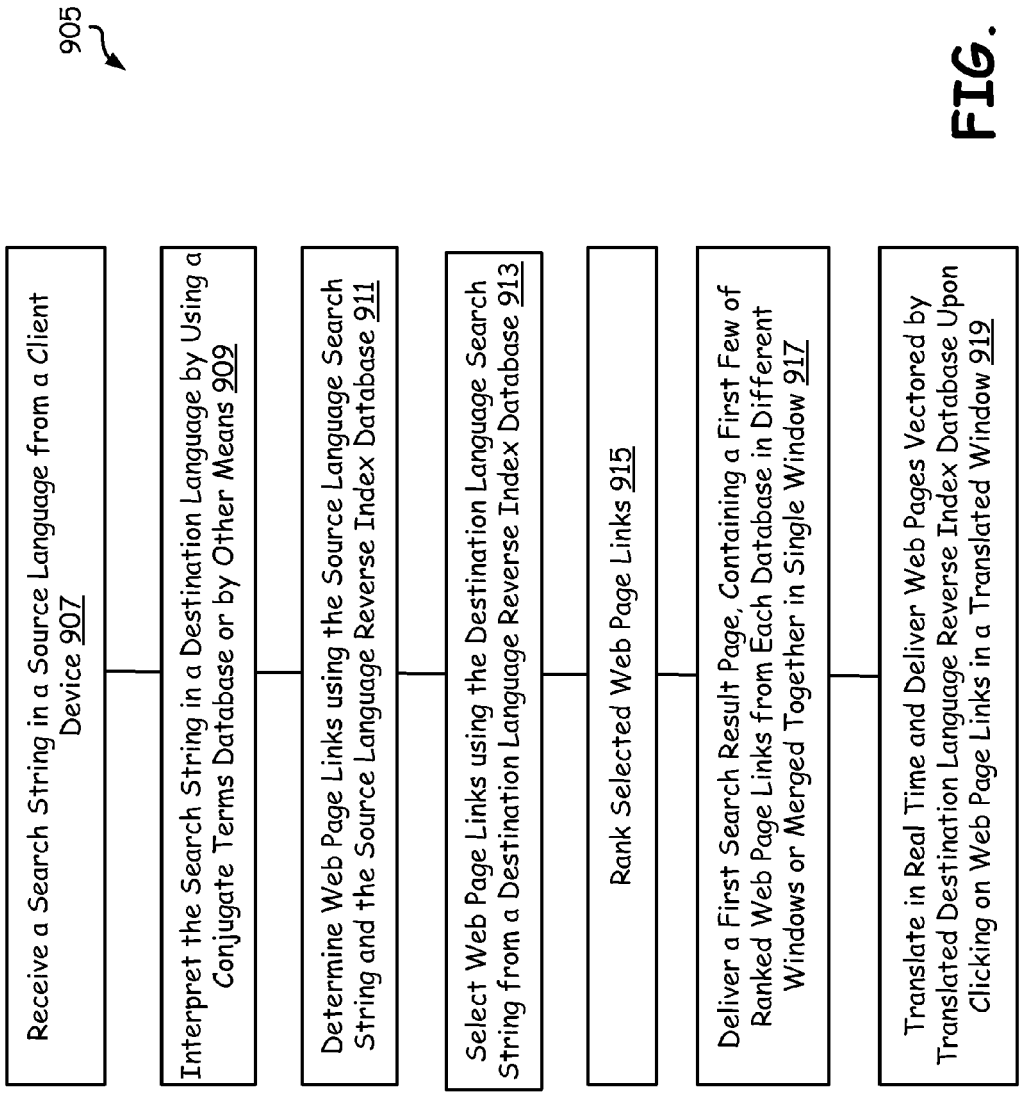

905
Receive a Search String in a Source Language from a Client Device 907
Interpret the Search String in a Destination Language by Using a Conjugate Terms Database or by Other Means 909
Determine Web Page Links using the Source Language Search String and the Source Language Reverse Index Database 911
Select Web Page Links using the Destination Language Search String from a Destination Language Reverse Index Database 913
Rank Selected Web Page Links 915
Deliver a First Search Result Page, Containing a First Few of Ranked Web Page Links from Each Database in Different Windows or Merged Together in Single Window 917
Translate in Real Time and Deliver Web Pages Vectored by Translated Destination Language Reverse Index Database Upon Clicking on Web Page Links in a Translated Window 919

FIG. 9

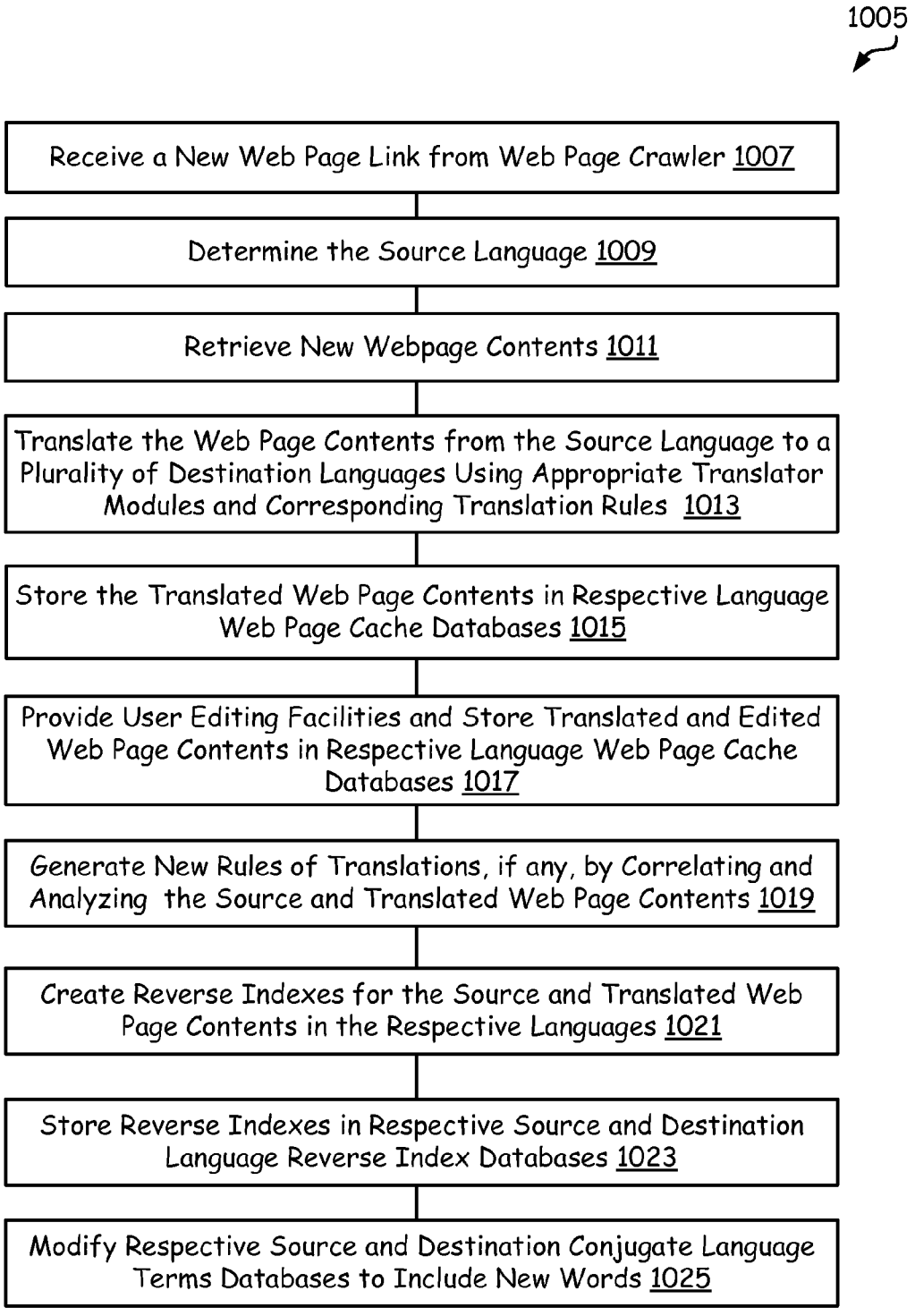

1005
Receive a New Web Page Link from Web Page Crawler 1007
Determine the Source Language 1009
Retrieve New Webpage Contents 1011
Translate the Web Page Contents from the Source Language to a Plurality of Destination Languages Using Appropriate Translator Modules and Corresponding Translation Rules 1013
Store the Translated Web Page Contents in Respective Language Web Page Cache Databases 1015
Provide User Editing Facilities and Store Translated and Edited Web Page Contents in Respective Language Web Page Cache Databases 1017
Generate New Rules of Translations, if any, by Correlating and Analyzing the Source and Translated Web Page Contents 1019
Create Reverse Indexes for the Source and Translated Web Page Contents in the Respective Languages 1021
Store Reverse Indexes in Respective Source and Destination Language Reverse Index Databases 1023
Modify Respective Source and Destination Conjugate Language Terms Databases to Include New Words 1025

FIG. 10

SUPPORT FOR INTERNATIONAL SEARCH TERMS-TRANSLATE AS YOU CRAWL

CROSS REFERENCE TO RELATED APPLICATIONS

The present U.S. Utility patent application claims priority pursuant to 35 U.S.C. §120 as a continuation of U.S. Utility application Ser. No. 13/589,314, entitled "SUPPORT FOR INTERNATIONAL SEARCH TERMS—TRANSLATE AS YOU CRAWL", filed Aug. 20, 2012, copending, scheduled to issue as U.S. Pat. No. 9,058,321 on Jun. 16, 2015, which is a continuation of U.S. Utility application Ser. No. 12/437,611, entitled "SUPPORT FOR INTERNATIONAL SEARCH TERMS—TRANSLATE AS YOU CRAWL," filed May 8, 2009, now issued as U.S. Pat. No. 8,250,083 on Aug. 21, 2012, which claims priority pursuant to 35 U.S.C. §119(e) to U.S. Provisional Application No. 61/053,712, entitled "SUPPORT FOR INTERNATIONAL SEARCH TERMS—TRANSLATE AS YOU CRAWL," filed May 16, 2008, all of which are hereby incorporated herein by reference in their entirety and made part of the present U.S. Utility patent application for all purposes.

BACKGROUND

1. Technical Field

The present invention relates generally to Internet infrastructures; and, more particularly, to search engines.

2. Related Art

A user, through direct and explicit knowledge, may know the addresses of only handful of web pages that provide relevant information. In the absence of such knowledge of the direct addresses of websites that would provide relevant information, the user typically resorts to search engines to find web pages related to business, commercial, scientific, shopping, other professional or home needs, and other uses. The user may use search engines for a wide variety of purposes such as shopping, seeking further information about professional needs (such as business and scientific needs), entertainment, downloading useful files, streaming video, etc.

However, search engines today have many shortcomings that limit the user's ability to search for information. One of these shortcomings is that when the user is in a foreign land where the spoken language(s) are different from what the user is familiar with, the search engines provide web page information in the local language and the user is not able to understand the information in these web pages. For example when an American visits Germany, and looks for hospital information for a health related issue, search engines may provide relevant information, but only in German language. Therefore, this information is unhelpful to the user.

In other circumstances, the search engines may provide web pages with some information in the native language of the user, but often the interpretations of these words are incorrect or out-of-date due to lack of real-time support. This confusion may also happen or be exacerbated if the search string provided has multiple meanings or translations in the local language. Some search engines provide translations of web pages, but these translations are not exact and do not provide clear information that correlates well to the information originally written in the original language. The user cannot search if he/she knows of no search terms in a local language in a new city and/or that infrastructure does not support translation and/or searching in the user's foreign language. For example, the user may be in a foreign land

searching for panels for outside of a house (that is, exterior wall covering or exterior paneling) or local restaurants, or for local news. For a non-English speaker, the entire searching process becomes difficult if not impossible. Therefore, a need exists for a more internationally compatible and friendly Internet infrastructure that accommodates international and multi-language searching, content, translation, and processing.

These and other limitations and deficiencies associated with the related art may be more fully appreciated by those skilled in the art after comparing such related art with various aspects of the present invention as set forth herein with reference to the figures.

BRIEF SUMMARY OF THE INVENTION

The present invention is directed to apparatus and methods of operation that are further described in the following Brief Description of the Drawings, the Detailed Description of the Invention, and the claims. Other features and advantages of the present invention will become apparent from the following detailed description of the invention made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram illustrating an Internet infrastructure containing a client device and web-browser-accessible foreign language support search engine server;

FIG. **2** is a schematic block diagram illustrating an Internet infrastructure, in continuation of FIG. **1**, wherein the foreign language support search engine server translates selected web pages upon an inquiry in real time and delivers them to the web browser in a desired language upon inquiry;

FIG. **3** is a schematic block diagram illustrating foreign language support databases of FIG. **1** in detail;

FIG. **4** is a schematic block diagram illustrating in more detail the web crawler support translator modules and independent database support translator modules of FIG. **1**;

FIG. **5** is a schematic block diagram illustrating in more detail the real time translator modules of FIG. **2**;

FIG. **6** is a schematic block diagram illustrating components of the foreign language support search engine server constructed in accordance with the embodiments of FIG. **1** and FIG. **2** of the present invention;

FIG. **7** is a snap shot or screen shot of a search result page containing web links of web pages in accordance with the embodiment of FIG. **1**;

FIG. **8** is a flow diagram illustrating functionality of the search engine server of FIG. **1**, during a search operation;

FIG. **9** is a flow diagram illustrating functionality of the search engine server of FIG. **2**, during a search operation; and

FIG. **10** is a flow diagram illustrating functionality of the search engine server of FIG. **1**, wherein the search engine server identifies a new web page in a source language during crawling, translates it to a plurality of destination languages, creates reverse indexes in respective languages, and stores both reverse indexes and cache web pages in a database.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram illustrating an Internet infrastructure **105** containing a client device **157** and (web browser accessible) foreign language support search engine server **169** connected via the Internet **107**. The

foreign language support search engine server **169** identifies new web pages in a source/original language by crawling servers on the Internet **107**, translates the web pages from the source/original language into a plurality of destination languages, creates reverse indexes in respective languages, stores both reverse indexes and cache web pages in a database, and delivers selected translated web pages to the web browser in the source and/or destination language upon inquiry.

In specific, the foreign language support search engine server **169** gathers new or changed web pages in plurality of supported major languages by crawling from one server, database, or web page to another and translates these new web pages from a source/original language to the rest of the supported major languages (destination languages) that the system is set to manage. The system then stores the supported major language translations in respective destination language cache databases. Since Internet content is continually changing, the crawling and translation of web content and pages is often a full time job for one or more servers or CPUs. Therefore, these translated pages must be updated on a fairly routine or continuous basis to remain current.

In another embodiment, the source web pages or servers can ping, interrupt, or notify the server **169** that it has made changes whereby the server **169** can remain current with consumption of less bandwidth and less consumed process time/power committed to updated or checking content that is static and unchanging over long periods of time. Such functionality may be accomplished by downloading an application from the foreign language support search engine server **169** to a server upon which translation has been performed. The foreign language support search engine server **169** also creates reverse indexes for these destination language databases and stores them in a separate destination language reverse index database or databases. These databases may physically be a single database, may only conceptually differ from one another or, in another embodiment, the databases may also be distributed in different locations around the world. In other words, the foreign language support search engine server **169** may be implemented as server clusters or cloud computing distributed in various physical locations over the Internet. This may also allow the databases to focus on only those languages that a have high interest in the local regions.

A search string **153** is entered from a web browser **151** or another client application of the client device **157** in one of the supported major languages (source language). Upon this event, the foreign language support search engine server **169** determines the search string language by either searching through conjugate terms databases (which contains all of the terms and strings in various supported major languages along with meanings or synonyms in rest of the supported major languages), by performing optical character recognition or spatial/pattern recognition on the text, or by identifying the domain name of the search engine query web page. Once the source language is identified, the foreign language support search engine server **169** determines the relevance of the web pages to the search string **153** in various languages by searching through the reverse index databases in all of the supported major languages. The server then selects web links that are pertinent to the search string **153** in all of the supported major languages and delivers both source language web links (typically, in one of the windows in a search result page) and web links in the rest (or some pre-selected one or more target languages) of the relevant supported major languages (in a second window or a segmented interface). That is, the second window may display web links from one or more of the destination languages translated to the source language, and the languages displayed for perusing may be all the supported language, the target language of the search string, or a plurality of target languages selected by the user in the browser interface or the control panel of the client device **157**. The web links in the second window may be coded so that they do not vector to the actual web pages in their respective servers, but they vector to the cached web pages of the source language cache databases properly translated (if required) by the foreign language support search engine server **169**. Upon clicking on these web links (in the second window), the foreign language support search engine server **169** delivers web pages from the desired language cache databases, and these stored web pages are already translated to the desired language.

For example, a search string **153** provided in the English language, that is entered in Germany, typically provides web links that vector to web pages in the German language alone. However, the foreign language support search engine server **169**, upon receiving a search string **153** in English provides not only the relevant web links of the English web sites, but also web links that vector to the foreign language support search engine server's **169** translated English language web page cache database (which among them contains the plurality of German web pages translated to English in the second window. Alternatively, a single window may also display search results in the English language mixed with translated German language web pages. And, as already discussed, the user may ask for the German pages to be provided in one or more of English, French, and Spanish (i.e., multiple other foreign languages).

In another embodiment, the foreign language support search engine server **169** provides real time translation support specifically while dealing with languages other than the supported major languages (such as ones that have few users where it is not cost effective to provide database support) or while working with dynamic web pages (whose contents change frequently). Therefore, translation support may be performed before a user access with the page(s) cached for prompt response to a user request. The system may cache or retain content in an untranslated original state and only translate for presentation to a user that content and those languages that are requested by the user. The second operation may provide a solution that uses less computational bandwidth, Internet bandwidth, and processing power/memory, whereas the first solution may improve the latency of providing meaningful data to the user in a timely manner. In some cases, a hybrid of the two approaches may work the best. In the case or real time translation processing, the foreign language support search engine server **169** translates the web pages of destination languages in real time and delivers translated pages to the web browser **151** (refer to the FIG. **2** for detailed description of real time translation services).

To store all of the source language web pages and respective translated web pages in other (destination) major languages and their reverse indexes (for quick search response), the foreign language support search engine server **169** contains a plurality of databases (which may conceptually be separate, but physically may be in a single database or even distributed among plurality of servers—server clusters—worldwide) via a foreign language support databases **195**. The foreign language support databases **195** in turn contain a plurality of conceptually distributed databases such as international language reverse index databases **181**, international language web page cache databases **183**, trans-

lated language reverse index databases **185** and translated language web page cache databases **187**. For example, the international language reverse index databases **181** and international language web page cache databases **183** may contain reverse indexes (containing search terms—or strings or phrases—and relevant web links linked to these terms) and cache web pages (frozen web pages at the time of crawling and identifying new web pages), respectively, in all of the supported major languages, such as English, German, French, Spanish, Chinese and Hindi. These databases **181** and **183** contain web pages that are retrieved from the respective servers without any alterations or translations. Similarly, translated language reverse index databases **185** and translated language web page cache databases **187** may contain reverse indexes and cache web pages, respectively, in all of the supported major languages other than the source language. For example, for every English language web page available in one of the international language web page cache databases **183**, the translated language web page cache databases **187** may contain in their respective destination language databases translated cache web pages in German, French, and Spanish; Chinese and Hindi (refer to FIG. **3** for detailed description of this functionality using the databases).

In addition to the databases, the foreign language support search engine server **169** contains a plurality of translators that translate web pages from their source languages to one/more/all other supported major languages (i.e., destination languages) and stores them in the respective translated language reverse index databases **185** and translated language web page cache databases **187**. The plurality of translators includes two or more different types (in different embodiments of the present invention or used together). In FIG. **1**, two specific different types of translators are specifically shown, that is, web page crawler support translator modules **175** and independent database support translator modules **177**. The web page crawler support translator modules **175** in turn contain a plurality of translators that translate a web page, in a source language (i.e., one of the major languages that are supported by the system), identified by a web page crawler module **173** during crawling operations, to a plurality of other languages (destination languages, all of the languages in the supported major languages other than the source language in one embodiment) and stores them in the respective translated language web page cache databases **187** and then, creates reverse indexes for each of these cache databases **187** and stores them in the respective translated language reverse index databases **185**. In another embodiment, translation may only occur on an as needed basis and may be temporarily cached to save translation processing on content this is hit often. Therefore, the translation process, as already discussed, can be real-time while web pages are requested or may be preformed off-line in the background so all content is translated and waiting once requested in a certain language by the user.

Returning to the example of FIG. **1**, a vector to an English language web page is identified by the web page crawler module **173** and is supplied to the web page crawler support translator modules **175**. Modules **175**, in turn, retrieve the English language web page and translate them into plurality of other supported major languages such as German, French, Spanish, Chinese and Hindi. Such languages may differ in different servers around the planet, as different regions will obviously favor different languages. In all, if there are four supported major languages, for example, then twelve translators are employed to perform translations into rest of the supported major languages. Therefore, the web page crawler support translator modules **175** may contain twelve translators, in this case, to support all language combinations. In other embodiments, use cases may indicate that translations between language one and language three are common whereby translations from language two to language four are uncommon or never requested. In these cases, some of the twelve (or whichever number) of combinations may be eliminated as the local use case allows.

Similarly, the independent database support translator modules **177** performs translations from a source language into the rest of the supported major languages, in another embodiment of the present invention, by accessing web pages from the international language web page cache databases **183** and translated language web page cache databases **187** directly. In other words, these translators **177** do not link to web page crawler module **173**, on the contrary, the translators **177** access web pages directly from cache databases **183** and **187**. Again, if there are four supported major languages, for example, then the independent database support translator modules **177** may contain up to translators, to perform translations into rest of the supported major languages. Refer to FIG. **4** and its corresponding text for a detailed description of the web page crawler support translator modules **175** and independent database support translator modules **177**).

To perform other search-operation-related functionalities, the foreign language support search engine server **169** contains web page ranking and listing module **179** and search string interpretation module **193**. The search string interpretation module **193** receives a search string **153** in a source language and determines its language by looking into the conjugate terms databases (not shown, refer to the FIG. **3** for detailed description of conjugate terms databases) and then retrieves conjugate source language terms, and may even facilitate translations as needed to render the search string compatible with the searchable content languages. The conjugate terms databases contain strings and terms from all of the supported major languages in one column along with a language tag in another column and a plurality of corresponding conjugate destination language strings and terms in a series of succeeding columns. In other embodiments, other data constructs can be used and will still be effective. The conjugate destination language strings and terms are retrieved when an 'enable international terms support' button is enabled in a search interface page of the foreign language support search engine server **169**, otherwise the same search strings or terms are used to conduct searching. The client device **157** illustrated in FIG. **1** is communicatively coupled to the foreign language support search engine server **169** via an Internet **107**.

An 'enable thesaurus' button provided in the search interface page of the foreign language support search engine server **169** and accessible via web browser **151** may be individually enabled or may be enabled along with the 'enable international terms support' button. If the 'enable thesaurus' button is individually enabled, then various synonyms of the search string are utilized for more comprehensive searching. Alternatively, if the 'enable thesaurus' button is enabled along with the 'enable international terms support' button, then the process of retrieving conjugate destination language strings or terms (mentioned in the above paragraphs) is accompanied by retrieving synonyms for the conjugate source language strings or terms from a thesaurus database (not shown specifically in FIG. **1**). This process of determining synonyms broadens the scope of search since exact translations in destination languages may not be available for the search string **153**. Once conjugate

destination language strings and terms and their synonyms are retrieved, they are utilized to select search result web links.

For example, if a user (who understands only English) is in Germany and wants to conduct a search using English terms, the search results are typically returned are German language web pages. Even though translation applications may be locally available on a client for some of the web pages, those translation operations are not exact. In other words, the user often cannot search in Germany if he/she does not use search strings entered in local language in a new city. The foreign language support search engine server **169**, in accordance with the teachings herein, allows the user to search using an English search string **153** (that is using words in a source language) by enabling 'enable international terms support' and/or 'enable thesaurus' buttons, and provides web links that vector to both English language web pages in their respective Internet servers and relevant German language web pages that are translated to English and are located in translated German language web page cache database (of translated language webpage cache databases **187**). Thus, for example, if the user is searching for hospitals in Germany, he/she may receive web links that provide local hospital information in English (by vectoring the web links to the translated original German web pages in the translated language web page cache databases **187**).

FIG. **2** is a schematic block diagram illustrating an Internet infrastructure **205**, in continuation of FIG. **1**, wherein the foreign language support search engine server **269** (similar to the server **169** of FIG. **1**) translates selected web pages upon inquiry in real time and delivers them to the web browser **251** (similar to the browser **151** of FIG. **1**) in a source language upon inquiry. Specifically, the foreign language support search engine server **269** identifies the source language of the search string **253** (upon inquiry in a source language via the web browser **251** on the client device **257**, in a search interface page on a screen of the client device **257**) and then selects and delivers web links of web pages in relevant source and destination languages derived from reverse index databases and cache databases and translates the relevant web content in real time upon clicking on the web links in the search result pages and delivers these translated web pages to the web browser **251** via the Internet **207** (similar or identical to the Internet **107** of FIG. **1**). The real time translation may occur on web pages of many destination languages that include supported major languages as well as other minor languages that have few users (where it is often not cost effective to provide database support) and dynamic web pages (whose contents change frequently). In these cases, the foreign language support search engine server **269** translates these web pages of destination languages in real time and delivers them to the web browser **151**. The translation occurs in real time upon clicking on the web links delivered in the search results pages. Therefore, a hybrid approach involving cached or database-stored pre-access translation and real-time translation on an as-needed basis for other content can be employed.

The foreign language support search engine server **269** utilizes reverse indexes of the source languages that are stored in international language reverse index databases **281** to select web links upon inquiry. These databases **281** may physically be a single database, may only conceptually differ from one another, or the databases may also be distributed in different locations around the world to enable cloud computing or peer-to-peer systems. In other words, the foreign language support search engine server **269** may be implemented as server clusters distributed in various physical locations.

The foreign language support search engine server **269** determines the language of the search string **253** in one of the supported major languages (source language) or other minor languages by either searching through conjugate terms databases (which contains all of the terms and strings in various supported major languages and other languages along with meanings or synonyms in rest of the supported major languages), by pattern/spatial/character recognition, and/or by identifying the domain name of the search interface page. Once the source language is identified, the foreign language support search engine server **269** determines the relevance of the web pages (to the search string **253**) in various languages by searching through the international language reverse index databases **281** and selects web links that are pertinent to the search string **253** and delivers these web links (typically, in multiple windows, via a search result page). Upon clicking on these web links (in a window that contains web links of web pages in languages other than source language), the foreign language support search engine server **269** delivers real-time translated web pages from international language web page cache databases **283** or may provide cached pre-translated pages from other transactions for high traffic content on the Internet **207**.

To store all of the source language web pages in supported major languages and other minor languages and their reverse indexes (for quick search response), the foreign language support search engine server **269** contains a plurality of databases (which may conceptually be separate, but physically may be in a single database or even distributed among plurality of servers—server clusters—worldwide), under the access and control of the international language reverse index databases **281** and international language web page cache databases **283**. For example, the international language reverse index databases **281** and international language web page cache databases **283** may contain reverse indexes (containing search terms—or strings or phrases—and relevant web links linked to these terms) and cached web pages (frozen web pages at the time of crawling), respectively, in all of the supported major languages and other languages, such as English, German, French, Spanish, Chinese, Hindi (supported major languages) and Swahili, Vietnamese, Czechoslovakian languages (other languages having much lesser number of users). These databases **281** and **283** contain web pages that are retrieved, by a web page retrieval module **273**, from the respective servers without any alterations or translations.

In addition to databases, the foreign language support search engine server **269** contains a plurality of translators that translate web pages in real time (though, possibly, at some cost of time of response and accuracy of translation) from their source languages to the language of inquiry and delivers them upon clicking on the web links, via real time translator modules **275**. If there are four supported major languages and other minor languages, for example, then up to twelve real time translators are employed to perform all relevant translations. Therefore, the real time translator modules **275** may contain twelve translators, in this case.

To perform other search operation related functionalities, the foreign language support search engine server **269** contains web page ranking and listing module **279** and search string interpretation module **285**. The search string interpretation module **285** receives a search string **253** in a source/search language and determines its language by looking into the conjugate terms databases (not shown, refer

to the FIG. **3** for detailed description of conjugate terms databases) and then retrieves conjugate source language terms from memory/storage. The conjugate terms databases contain strings and terms from all of the supported major languages in one column along with a language tag in another column and a plurality of corresponding conjugate destination language strings and terms in a series of succeeding columns. Other data structures and methods can also be used to store this information in a manner suitable for use herein. The client device **257** illustrated in FIG. **2** is communicatively coupled to the foreign language support search engine server **269** via an Internet **207**.

As an example of the operation of FIG. **2**, if a user (who understands only the Czech language, which is not one of the supported major languages and has only few users) were to be in Germany and were to conduct a search using Czech language terms, what typically comes back are web links of German web pages. The foreign language support search engine server **269**, in accordance with the teachings herein and in these cases, will allow the user to search using an Czech language search string **253** (that is using words in a source language) by enabling 'enable international terms support'. The system then provides web links that vector to Czech language web pages in their respective Internet servers and that vector to relevant German language web pages available in the international language web page cache databases **283**. Thus, for example, if the user is searching for travel agents in Germany or Czech Republic, he/she may receive web links that provide information about German and Czech Republic travel agents in Czech language. When the user clicks on the web links (of travel agents in German language), the foreign language support search engine server **269** delivers real time translated web pages from, for example, a Czech language web page cache database (one of the international language web page cache databases **283**).

FIG. **3** is a schematic block diagram **305** illustrating foreign language support databases **395** of FIG. **1**, in detail. Specifically, the foreign language support search engine server **369** contains a plurality of databases to store all of the source language web pages and respective translated web pages in the destination major languages along with their reverse indexes (for quick search response), using the foreign language support databases **395**. The foreign language support databases **395** in turn contain a plurality of conceptually distributed databases in various languages. For example, as pertaining to English language, a typical source language, the foreign language support databases **395** may contain databases such as English language reverse index database **331**, English language web page cache database **333**, translated English language reverse index databases **335**, translated English language web page cache database **337** and conjugate English language terms database **339**. The conjugate English language terms database **339** contain strings and terms from English language in one column or database construct along with a language tag and a plurality of corresponding conjugate destination language strings and terms in a series of succeeding columns or different database constructs. The foreign language support search engine server **369** is communicatively coupled to Internet **307** in FIG. **3**.

As an example of the operation of FIG. **3**, the English language reverse index database **331** and English language web page cache databases **333** may contain reverse indexes (containing English search terms—or strings or phrases—and relevant web links of English web pages linked to these terms) and cache web pages (frozen English web pages at the time of crawling and identifying new web pages), respectively. These databases **331** and **333** contain English web pages that are retrieved from the respective servers without any alterations or translations. Similarly, translated English language reverse index database **335** and translated English language web page cache database **337** may contain reverse indexes and cache web pages translated to English from all of the other supported major languages other than the English language.

Similarly, the foreign language support databases **395** may contain a plurality of databases in various other languages such as German, by using the German language reverse index database **341**, German language web page cache database **343**, translated German language reverse index databases **345**, translated German language web page cache database **347** and conjugate German language terms database **339**, as well as in rest of the supported major languages such as French, Spanish, Chinese and Hindi (supported major languages) and other languages having much lesser number of users such as Swahili, Vietnamese and Czech languages. Therefore, FIG. **3** illustrates the kind of software, databases, and information is needed per language and per system in order to enable the language translation taught herein. And, as already noted, these databases and software may be distributed among clients, other servers, and other devices/storage/memory over the Internet.

FIG. **4** is a schematic block diagram **405** illustrating web crawler support translator modules **495** and the independent database support translator modules **497** (similar to modules **175** and **177** of FIG. **1**) in greater detail. The foreign language support search engine server **469** (similar to server **169** of FIG. **1**) contains a plurality of translators that translate web pages from their source languages to all other supported major languages (i.e., destination or target languages) and stores them in the respective translated language reverse index databases and translated language web page cache databases (not shown, but refer to FIG. **3** for detailed descriptions of these elements). The plurality of translators belongs to two different categories. A first category being web page crawler support translator modules **495** and a second category being independent database support translator modules **497**. In other embodiments, fewer or more translator constructs may be present in FIG. **4**.

The web page crawler support translator modules **495** in turn contain a plurality of translators that translate a new web page from a source or original language (i.e., one of the supported major languages), that is identified by a web page crawler module (not shown) during crawling operations, to a plurality of other languages (destination languages, all of the languages in the supported major languages other than the source language). The modules **495** store the translations and related data in the respective translated language web page cache databases (not shown in FIG. **4**, but preferably a part of the local storage discussed in FIG. **6**) and then, creates reverse indexes for each of these cache databases (not shown in FIG. **4**, but usually part of system storage/memory) and stores them in the respective translated language reverse index databases (not shown in FIG. **4**).

In all, if there are four supported major languages, for example, then up to twelve translators are employed to perform translations into rest of the supported major languages. Other translators may be employed if a dialect has many different versions. An example may be that English may have different translations if the target region is England, versus the US, versus Australia. Therefore, the web page crawler support translator modules **495** may contain twelve translators, in this case, or more or fewer translators

if other language or dialect versions are supported. The web page crawler support translator modules **495**, for example, may contain English-German translator module **431**, English-French translator module **433**, English-Hindi translator module **435** (and so on, covering all other supported major languages, that is, English to all other major languages translator modules) and then, German-English translator modules **437** (and again covering all other supported major languages, that is, German to all other major languages translator modules).

In addition, there are other modules in the web page crawler support translator modules **495** that assist the plurality of translator modules such **431**, **433**, **435**, and **437**. These include translated web page correlation modules **439**, multi-language translation rule modules **441**, and user edit translation rule analysis modules **443**. The user edit translation rule analysis modules **443** allow users who receive various translated web pages to correct or modify them as they think necessary to extract proper meanings from translated sentences in a given context. The translated web page correlation modules **439** compare the web pages translated by translator modules such as **431**, **433**, **435** and **437** with the source web pages by utilizing many inputs such as the ones obtained by the user modifications and corrections and then arrive at rules or augmented processes that would be employed by the translator modules such as **431**, **433**, **435** and **437** in all future translations. All of the translations done by the translator modules such as **431**, **433**, **435**, and **437** are assisted and governed by the multi-language translation rule modules **441**. Therefore, with the modules **439**, **441**, and **443**, the system can self correct over time or learn in an artificial intelligence manner, by employing the collective feedback of millions of users and other insight over time. This feedback could also be reviewed by IT professionally that run the server **469** to ensure that the translations are not being sabotaged or virally infected in an adverse manner.

Similarly, the independent database support translator modules **497** perform translations from a source language into the rest of the supported major languages (i.e., destination or target languages), by accessing web pages from the international language web page cache databases (not shown, but usually resident in server storage/memory) and translated language web page cache databases (not shown, but usually resident in server storage/memory, see FIG. **6**) directly. In other words, these translators **497** access web pages directly from cache databases and translate them as necessary. Again, if there are four supported major languages, for example, then the independent database support translator modules **497** may contain up to twelve translators, to perform translations into rest of the supported major languages.

The independent database support translator modules **497**, for example, may contain English-German translator module **451**, English-French translator module **453**, English-Hindi translator module **455** (and so on, covering all other supported major languages, that is, English to all other major languages translator modules) and then, German-English translator modules **457** (and ongoing again to cover all other supported major languages, that is, German to all other major languages translator modules).

In addition, there are other modules in the independent database support translator modules **497** that assist the plurality of translator modules such **451**, **453**, **455**, and **457**. These include translated web page correlation modules **459**, multi-language translation rule modules **461**, and user edit translation rule analysis modules **463**. These modules **459**, **461** and **463** function in analogous manner to that of modules **439**, **441**, and **443** mentioned in the above paragraphs for FIG. **4**.

FIG. **5** is a schematic block diagram **505** illustrating real time translator modules **569** of FIG. **2**, in more detail. The foreign language support search engine server **569** (analogous to the server **169** of FIG. **1**) contains a plurality of real time translator modules **595** that translate web pages in real time from their source languages to all other supported major languages and other minor languages (i.e., the destination or target languages) and deliver them to the web browsers (see FIGS. **1-2**) upon inquiry and request. In all, if there are four supported major languages and other minor languages, for example, then up to twelve real time translators are employed to perform translations into one of the supported major languages or other minor destination languages. Therefore, the foreign language support search engine server **569** may contain twelve translators, in this case. The foreign language support search engine server **569**, for example, may contain English-German translator module **531**, English-French translator module **533**, English-Hindi translator module **535** (and so on, covering all other supported major languages, that is, English to all other major languages translator modules) and then, German-English translator modules **537** (and again covering all other supported major languages, that is, German to all other major languages translator modules). These translators **531**, **533**, **535** and **537** are programmed to function in real time in one embodiment. In another embodiment, the translators can be programmed to function off-line or in a combination of off-line and real-time processing modes. If these modules function in real time, they will operate after the user at a client device receives search results in terms of web links that may also contain some translated web links of languages other than the source language, and clicks upon one of these web links. The translators **531**, **533**, **535** and **537** receive web pages that belong to languages other than the source language from their respective Internet servers and then, before delivery, they translate this web content to the source language.

In addition, the foreign language support search engine server **569** contains other modules that assist the plurality of real time translator modules such **531**, **533**, **535**, and **537**. These include multi-language translation rule modules **539**. All of these translations are done by the real time translator modules, such as modules **531**, **533**, **535** and **537**, and are assisted and governed by the multi-language translation rule modules **539**. It is important to note that most embodiments herein are discussed in terms of finding web pages in a source language and converting them, either real-time or off-line, to target languages to allow for international use. However, other methods may be used, using the systems taught herein. For example, a server may crawl international sites in other languages and covert those web pages to the original/source language used in the region that is served by the server. For example, a server **169** in the US, could crawl or seek out pages in France and Germany and grab those pages in the local languages and convert them to English and store them in the US so that US users could access content previously only available in Europe and then only available in foreign languages (in this case, German and French). Therefore, the various methods of translating and converting web content to make it more accessible to other users that use other languages can vary, but achieve the same end objective.

FIG. **6** is a schematic block diagram **605** illustrating components of the foreign language support search engine

server **607** constructed in accordance with the embodiments of FIG. **1** and FIG. **2** of the present invention. The foreign language support search engine server circuitry **607** may in part or in full be incorporated into any computing device that is capable of serving as an Internet based server or client device. The foreign language support search engine server circuitry **607** generally includes processing circuitry or CPU(s) **609**, local storage/memory **617**, manager interfaces **649**, and network interfaces **641**. These components are communicatively coupled to one another via one or more of a system bus, dedicated communication pathways, or other direct or indirect communication pathways as shown in FIG. **6**. The processing circuitry or CPU **609** may be, in various embodiments, a microprocessor, a graphics processing unit, a digital signal processor, a state machine, an application specific integrated circuit, a field programming gate array, combinations thereof, multi-core processors, or other processing circuitry.

The network interfaces **641** contain wired, optical, and/or wireless packet switched (or other) interfaces **645** and may also contain built-in or an independent interface processing circuitry or CPU(s) **643**. The network interfaces **641** allow the foreign language support search engine server **607** to communicate with client devices, such as client device **661** of FIG. **6** via the Internet **655** and to deliver search result pages and web content in the source language and/or translated language web pages to web browser **651** in FIG. **6**. Such searches are initiated via the provision of one or more search strings **653** or search data within the client device **661** of FIG. **6**. The manager interfaces **649** may include a display and/or keypad interfaces. These manager interfaces **649** allow the user or IT professional at the foreign language support search engine server **607** to control aspects of the system and its performance/functionality/security. The client device **661** illustrated in FIG. **6** is communicatively coupled to the foreign language support search engine server **607** via the Internet **655**, which is analogous to the Internet **107** of FIG. **1**.

Local storage/memory **617** may be any type of random access memory, read-only memory, electrically erasable memory, non-volatile memory, flash memory, a disk drive, an optical drive, cache memory, combinations thereof, or another type of memory that is operable to store computer instructions and/or data. The local storage **617** stores software/data to embody a search string interpretation module **619**, web page crawler support translator modules **621**, independent database support translator modules **623**, real time translator modules **625**, web page ranking and listing module **627**, foreign language support databases **629**, thesaurus databases **631**, conjugate terms databases **633**, and web page crawler module **635**. These modules **619**, **621**, **623**, **625**, **627**, **629**, **631**, **633**, and **635** of FIG. **6** facilitate the interpretation of the search string that may include translation operations, the identification of new web pages in a source language by a crawling process, followed by various translation(s) into a plurality of destination languages, ranking/ordering/rating of web pages that are placed in search result lists as part of a search operation, the creation of reverse indexes in respective languages, the enabling of searching based on search string synonyms or a thesaurus database, the storing of both reverse indexes and cache web pages, and the delivery of selected translated web pages to the web browser in the source language upon inquiry. These operations are discussed in more detail in following paragraphs.

Upon receiving a search string **653** in one of the supported major languages (source language) or other minor languages (a minor source language), the search string interpretation module **619** determines the language of the search string by either searching through the conjugate terms databases **633**, via pattern/character/optical/spatial recognition and/or by identifying the domain name of the search engine query web page. Once the source language of the search string is identified, the web page ranking and listing module **627** determines the relevance of the various search results or web links to the search string **653**. The search results may belong to various languages and require translation operations or processing by searching through the reverse index databases (contained in the foreign language support databases **629**) in all of the supported major languages and other minor languages. Eventually, corresponding web pages are selected and the web page's web links that are pertinent to the search string **653** are delivered in either or both the source language and one or more target or destination languages (vectored to the web pages in the foreign language support databases **629**).

The local storage/memory **617** also contains a plurality of translators that translate web pages from their source languages to all other supported major destination/target languages and store them in the foreign language support databases **629**. The plurality of translators includes three types of translators (in different combination in different embodiments herein), that is, web page crawler support translator modules **621**, independent database support translator modules **623**, and real time translator modules **625**. The web page crawler support translator modules **621** in turn include a plurality of translators that translate a new web page from a source language identified by a web page crawler module **635** during crawling operations, to a plurality of other destination/target languages and stores them in the foreign language support databases **629** or some other storage/memory construct within the server or over the Internet or other local peripheral bus structures that connect to additional storage. Then, the web page crawler support translator modules **621** creates reverse indexes for each of the cache databases contained in the foreign language support databases **629** and stores them in the respective reverse index databases which are also contained in the foreign language support databases **629**.

The independent database support translator modules **623** perform translations from a source language into one or more of the supported major destination or target languages (or some subset thereof selected by the user or designated by the region services by the server) by accessing web pages from the foreign language support databases **629** directly. That is, these independent database support translator modules **623** do not link to web page crawler module **635** in one embodiment, and on the contrary, these modules access web pages directly from the foreign language support databases **629**.

The real time translator modules **625** provide real time translation support to the users, specifically while dealing with the other minor languages requirements (e.g., processing in a special manner those languages that have fewer users where it is not cost effective to provide database and continuous support for those minor languages) or while dealing with dynamic web pages (whose contents change frequently). An example of a page that changes frequently is CNN.com where news changes many times over the course of the day. In these cases, the real time translator modules **625** access the requested web pages in the source or destination languages from their respective Internet servers, translates them in real time, and delivers that content to the web browser **651**.

In the case of all of these three types of translators **621**, **623**, and **625**, if there are four supported major languages and other minor languages, for example, then the translator modules **621**, **623**, and **625** may contain up to twelve translators each, to perform translations into the rest of the supported major destination/target languages and other minor destination/target languages, as mentioned in the previous paragraphs.

The foreign language support databases **629** contain a plurality of conceptually distinct databases to store all of the source language cache web pages, respective destination language translated web pages, and their reverse indexes (for quick search response). These databases include international language reverse index databases, international language web page cache databases, translated language reverse index databases, and translated language web page cache databases as taught herein. The conjugate terms databases **633** contain strings and terms from all of the supported major languages and other minor languages in one column along with a language tags and a plurality of corresponding conjugate destination language strings and terms in a series of succeeding columns. Further, other data constructs, like trees, linked lists, arrays, rows, etc., can be used to construct the data and database used for databases **633**. The local storage also contains a thesaurus database **631**, containing synonyms to various terms in a plurality of languages, to provide synonym support to the search operations.

In other embodiments, the foreign language support search engine server **607** of the present invention may include fewer or more components than are illustrated as well as lesser or further functionality. In other words, the illustrated foreign language support search engine server is meant to merely offer one example of possible functionality and construction in accordance with the present invention.

FIG. **7** is a snap shot or screen shot of a search result page **705** containing web links of web pages in accordance with system embodiment shown in FIG. **1**. Specifically, the snap shot illustrated in FIG. **7** shows a search result page **705** delivered to web browser **795** of a client device (as shown in FIGS. **1-2**). The screen of FIG. **7** contains selected source language web links as well as translated web page web links as provided to the web browser in the source and/or destination/target language upon an inquiry (in this case the search string of inquiry is shown in FIG. **7** as 'Drywall' **725**).

The search result page **705** that is delivered to the client device may contain a page title such as 'Search Engine's Web Page (www.Search_Engine.com)' **721**. It may also contain a title such as 'SEARCH ENGINE.COM' **741** and a tool bar **751** providing access to other selections, menus, or pages of the search engine server or browser. Two language selection tools **745** and **749** that are shown as selecting English **743** (as the source language) and Hindi **747** (as the destination language) may also be provided. This interface (or an interface similar to it) allows users to choose a source language (English, in this case) and a destination language (Hindi, in FIG. **7**) as shown in this page/screen example.

A text area such as 'Enter Search String:' **723** and text box **727** are provided to facilitate user's further search, in one of the windows. In this case, "drywall" **725** is the text entered into this field. This user entry window area may also contain buttons/selections such as 'Enable International Terms Support' **729**, 'Enable Thesaurus' **733**, and 'Enable Translation' **735** or other buttons/selections as illustrated in FIG. **7**. These buttons provide user options to perform one or more searches using a source and destination language or languages, synonyms, and translation support in any combination.

In this snap shot of FIG. **7**, the search result page **705** shows results for the search string 'Drywall' **725** based upon both the term 'Drywall' itself as well as the conjugate Hindi term 'Gypsum'. The search results based upon the English term 'Drywall' are provided in a second window such as windows **751** and **752**, and the window(s) may have a title such as 'Search Results in English Language **755**' in FIG. **7**. And, the translated search results based upon the Hindi search term 'Gypsum' is provided in another/third window such as window **761** in FIG. **7**, where the window has a title 'Search Results in English (Translated from Hindi) **757**'. The third window results are provided because of the user enabling 'Enable International Terms Support' **729** and 'Enable Translation' **735** buttons in the search interface page prior to display of the current search result page **705**.

The search result page **705** also contains the 'prev' **785** and 'next' **789** buttons to access prior displayed search result pages and the subsequent search result pages, respectively, and a search button **739** which allows a user to commence one or more searches inside a browser or other application. A helpful note such as "Note: Enabling 'International Terms Support' provides International Web Pages, enabling 'Translation' provides Translated International Web Pages" **393** may also be provided. Other configurations and special/graphic elements may be provided in an interface to the user, so other configurations and schemes other than that shown in FIG. **7** may be used. And, such interfaces may be configurable by a user or an operating system of a computer.

FIG. **8** is a flow diagram **805** illustrating the functionality of the search engine server of FIG. **1**, during a search operation. The functionality **805** begins at a block/step **807**, with the foreign language support search engine server receiving one or more search strings (in a source/search language, that is, one of the supported major languages listed by and supported by the search engine server) from one or more client devices (see FIGS. **1-2**). Then, at a next block/step **809**, the search engine server interprets the search string or portions thereof in the destination language by using conjugate terms database or by other means (such as considering the domain name of the search engine's query interface page, or doing language/pattern recognition). The conjugate terms databases contain strings and terms from the source language in one column along with a language tags and a corresponding conjugate destination language strings and terms in other columns, or another data structure.

At a next block/step **811**, the search engine server determines applicable search result web page links using a source language search string as processed by a source language reverse index database. That is, the search engine server contains both source (international) language reverse index databases and source (international) language web page cache databases that contain reverse indexes (containing search terms, or strings/phrases, and relevant web links linked to these terms) and cache web pages (frozen web pages at the time of crawling and identifying new web pages), in all of the supported major languages, such as English, German, French, Spanish, Chinese and Hindi. These source language databases contain web pages that are retrieved from the respective servers without any alterations or translations.

At a next block/step **813**, the search engine server selects web page links that correlate with the search string or portions thereof using a destination language friendly version of the search string from a destination language reverse

index database. The search engine server also contains destination (translated) language reverse index databases and destination (translated) language web page cache databases that contain reverse indexes and cache web pages, respectively, in the destination language. For example, for every English language web page available in an English language web page cache databases, the translated language web page cache databases may contain in their respective destination language databases translated cache web pages in German, French, Spanish, Chinese, and Hindi.

At a next block/step **815**, the search engine server ranks selected source and destination language web pages on the basis of extent of match and/or popularity. At a next block/step **817**, the search engine server delivers a first search result page containing a first few of the ranked web page links from each of the reverse index databases in different windows or merged together in a single window. At a final block/step **819**, the search engine server retrieves and delivers corresponding web pages from the destination (translated) language web page cache database upon clicking on web page links in the translated window or some other interface provided to the user.

FIG. **9** is a flow diagram illustrating the functionality **905** of the search engine server of FIG. **2**, during a search operation. The functionality **905** begins at a block/step **907**, with the foreign language support search engine server receiving a search string in a source/search language from the client device. Then, at a next block/step **909**, the search engine server interprets/translates/processes the search string as needed to a destination language by using conjugate terms database or by other means (such as considering the domain name of the search engine's query interface page, or performing character/pattern/spatial recognition).

At a next block/step **911**, the search engine server determines relevant search result web page links using the source and/or destination language search string from source language reverse index database (the search engine server contains both source (international) language reverse index databases and source (international) language web page cache databases that contain reverse indexes and cache web pages, in all of the supported major languages, such as English, German, French, Spanish, Chinese and Hindi. At a next block/step **913**, the search engine server selects search results or web page links using destination language search string from destination language reverse index database. The search engine server also contains destination/translated language reverse index databases and destination/translated language web page cache databases that contain reverse indexes and cache web pages, respectively, in the destination language.

At a next block/step **915**, the search engine server ranks selected source and destination language web pages on the basis of extent of match and/or popularity or some other ranking criterion or criteria. At a next block/step **917**, the search engine server delivers a first search result page containing a first few of the ranked web page links from each of the reverse index databases in different windows or merged together in a single window. At a final block/step **919**, the search engine server retrieves, translates in real time, and delivers corresponding translated web pages upon clicking on web page links in the translated window.

FIG. **10** is a flow diagram that illustrates the functionality **1005** of the search engine server of FIG. **1**, wherein the search engine server identifies a new web page in a source language during crawling, translates it to a plurality of destination languages, creates reverse indexes in respective languages, and stores both reverse indexes and cache web pages in a database for later use. The functionality **1005** begins at a block/step **1007**, wherein the foreign language support search engine server receives a new web page link from the web page crawler. The web page crawler module identifies the new web pages by a crawling process that is, by jumping to one of the web links presented in one of the web pages, moving to that web page and then moving to another web page by using web links presented in the current web page (a hierarchical traversing of the web page contents and sub-contents).

At a next block/step **1009**, the search engine server determines the source language of the new web page. The search engine server determines its source language by either searching through conjugate terms databases (which contains all of the terms and strings in various supported major languages along with meanings or synonyms in rest of the supported major languages), by pattern or character recognition, or by identifying the domain name of the search engine query web page. At a next block/step **1011**, the search engine server retrieves the new web page contents (a file or several files from the Internet server).

At a next block/step **1013**, the search engine server translates the new web page contents in a source language to one or a plurality of destination languages using appropriate translators modules and corresponding translation rules as taught herein in FIGS. **1-6**. At a next block/step **1015**, the search engine server stores the translated web page contents in respective web page cache databases. In other words, the translator modules contain a plurality of translators that translate the new web page identified by the web page crawler module during crawling operations to plurality of other languages (destination languages, which in one embodiment is all of the other languages in the supported major languages other than the source language), and stores them in the respective translated language web page cache databases. In all, if there are five supported major languages, for example, then twenty translators are employed to perform translations into rest of the supported major languages. For N languages, where N in an integer, N*(N−1) translators are needed to handle all the pairs of two languages that require translation in the system.

Then, at a next block/step **1017**, the search engine server provides user-editing facilities to the users who receive the translated new web page and stores this edited and translated new web page in a respective language web page cache database. Sometimes, the editing can be previewed by an IT expert resident at the server using the interface **649** of FIG. **6** before allowing that user feedback to be incorporated into the server data. At a next block/step **1019**, the search engine server generates new rules of translations, if any, by correlating and analyzing the new web page contents and translated and edited new web page contents, as optionally approved by IT oversight as taught herein. That is, the search engine server compares the web pages translated by translator modules and edited by the users with the source web pages by utilizing many inputs such as the ones obtained by the user modifications and corrections and then arrive at rules that would be employed by the translator modules in all future translations, and stores these rules in appropriate databases. In other words, the system can learn or use artificial intelligence methods employed across millions of users to improve its ability to translate over time.

The search engine server, at a next block/step **1021**, creates reverse indexes for the new web page and translated new web page contents in the respective languages supported by the server. At a next block/step **1023**, the search engine server stores these reverse indexes in respective

source and destination language reverse index databases. In other words, the search engine server retrieves stored web page contents contained in the translated language web page cache databases appropriately and creates reverse indexes for each of these cache databases and then stores them in the respective translated language reverse index databases. At a final block/step **1025**, the search engine server modifies respective source and destination conjugate terms databases to include new words derived from the new web page and the translated web page.

The terms "circuit" and "circuitry" as used herein may refer to an independent circuit or to a portion of a multifunctional circuit that performs multiple underlying functions. For example, depending on the embodiment, processing circuitry may be implemented as a single chip processor or as a plurality of processing chips. Likewise, a first circuit and a second circuit may be combined in one embodiment into a single circuit or, in another embodiment, operate independently perhaps in separate chips or may be split in more sub-component circuits. The term "chip," as used herein, refers to an integrated circuit (IC). Circuits and circuitry may comprise general or specific purpose hardware, or may comprise such hardware and associated software such as firmware or object code.

As one of ordinary skill in the art will appreciate, the terms "operably coupled" and "communicatively coupled," as may be used herein, include direct coupling and indirect coupling via another component, element, circuit, or module where, for indirect coupling, the intervening component, element, circuit, or module may or may not modify the information of a signal and may adjust its current level, voltage level, and/or power level. As one of ordinary skill in the art will also appreciate, inferred coupling (i.e., where one element is coupled to another element by inference) includes direct and indirect coupling between two elements in the same manner as "operably coupled" and "communicatively coupled."

The present invention has also been described above with the aid of method steps illustrating the performance of specified functions and relationships thereof. The boundaries and sequence of these functional building blocks and method steps have been arbitrarily defined herein for convenience of description. Alternate boundaries and sequences can be defined so long as the specified functions and relationships are appropriately performed. Any such alternate boundaries or sequences are thus within the scope and spirit of the claimed invention.

The present invention has been described above with the aid of functional building blocks illustrating the performance of certain significant functions. The boundaries of these functional building blocks have been arbitrarily defined for convenience of description. Alternate boundaries could be defined as long as the certain significant functions are appropriately performed. Similarly, flow diagram blocks may also have been arbitrarily defined herein to illustrate certain significant functionality. To the extent used, the flow diagram block boundaries and sequence could have been defined otherwise and still perform the certain significant functionality. Such alternate definitions of both functional building blocks and flow diagram blocks and sequences are thus within the scope and spirit of the claimed invention.

One of average skill in the art will also recognize that the functional building blocks, and other illustrative blocks, modules and components herein, can be implemented as illustrated or by discrete components, application specific integrated circuits, processors executing appropriate software and the like or any combination thereof.

Moreover, although described in detail for purposes of clarity and understanding by way of the aforementioned embodiments, the present invention is not limited to such embodiments. It will be obvious to one of average skill in the art that various changes and modifications may be practiced within the spirit and scope of the invention, as limited only by the scope of the appended claims.

The invention claimed is:

1. A search engine system that delivers search results via an Internet, the search engine system comprising:

at least one processor configured to implement:

a web crawler module, the web crawler module configured to:

crawl the Internet to gather a first web page having first text content in a first language;

identify the first language during crawling operations, at least in part, by processing a domain name;

a language processing service module, the language processing service module configured to, during the crawling operations, translate the first text content into both a second language in a form of second text content and a third language in a form of third text content using both a thesaurus database and a conjugate terms database;

at least one database structure, the at least one database structure, during the crawling operations, storing indexed representations of each of the first text content, the second text content, and the third text content; and

a search processing service configured, in response to receiving search input in the second language, to identify within the at least one database structure at least a portion of the indexed representation of the second text content.

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